

**REMARKS**

Applicants respectfully request reconsideration of the present application in view of the foregoing amendments and in view of the reasons that follow. After amending the claims as set forth above, claims 1, 3-5, 10-18, 20-22, and 24-33 are now pending in this application.

Applicants wish to thank the Examiner for the careful consideration given to the claims.

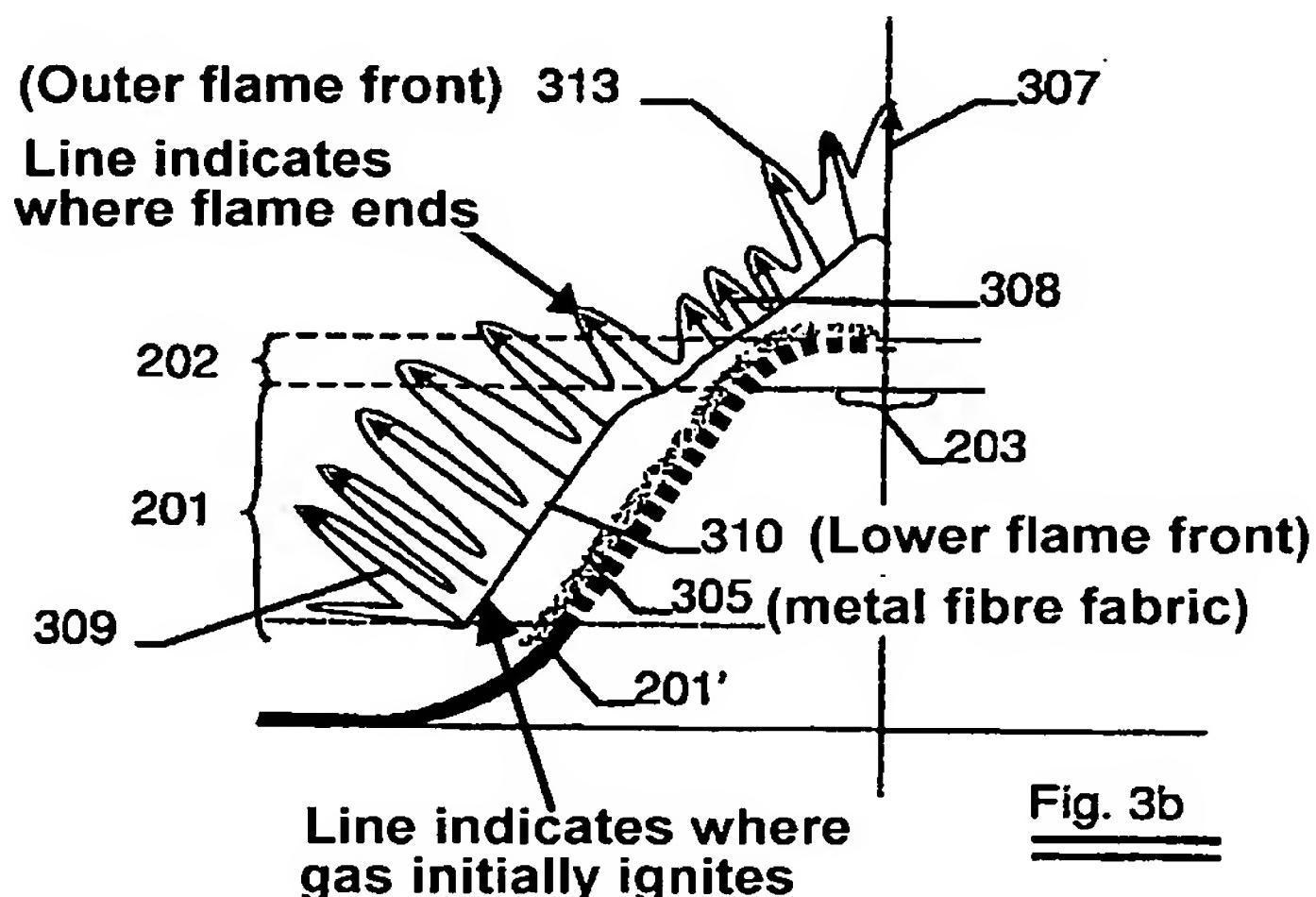
**Declaration of Geert Folkers**

A declaration under 37 C.F.R. 1.132 by Geert Folkers (“Folkers declaration”), one of the inventors and employee of the assignee of the present application, is being submitted herewith. The declaration provides evidence related to the nature of radiant burners and non-radiant burners.

**Rejection of claim 1 based on 35 U.S.C. 112**

Claim 1 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite because, in relation to the feature “having a lower flame front where the gas ignites outside said membrane,” “it is unclear where the flame front is lower in relation to other sections of the flame.” (Page 2 of the Office Action.) Claim 1 is definite and clear.

Claim 1 has been amended to recite “having a lower flame front where the gas initially ignites outside said membrane.” Fig. 3b of the specification (provided below) shows the lower flame front as being at the point where the gas initially ignites after it has flowed through the knitted metal fibre fabric.



Page 8, lines 15-17 of the specification provides: "Also the lower flame front 310--where the gas ignites--and the outer flame front 313--where the top of the flame is--is indicated for each of the sections." From these disclosures, one of ordinary skill in the art would understand that the lower flame front is that location in which the gas first ignites and is located at a distance from the metal burner membrane. One of ordinary skill in the art would understand what the lower flame front is and where it is in relation to the other sections of the flame (such as the outer flame front). Accordingly, claim 1 is definite.

For at least these reasons, favorable consideration of the rejection is respectfully requested.

Rejection of claims 1, 5, 11, 20-22, and 24-26 based on Saponara and Marrecau

Claims 1, 5, 11, 20-22, and 24-26 are rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over U.S. Patent No. 3,122,197 ("Saponara") and U.S. Patent No. 6,149,424 ("Marrecau"). For at least the following reasons, this rejection is traversed.

Claim 1 recites, among other things, a metal burner membrane configured such that, during use, gas penetrates before being ignited and resulting in visible flames having a lower flame front where the gas initially ignites outside said membrane. The membrane comprises a fabric comprising stainless steel fibers, wherein the membrane of the gas burner comprises a base section having a smallest radius of curvature being  $R_{base}$ , a closing section, and a transition region connecting the base section to the closing section. The membrane is uninterrupted. The transition region has a smallest radius of curvature  $r_{transition}$  being larger than or equal to  $0.02 \times R_{base}$  and being smaller than or equal to  $0.7 \times R_{base}$ . Saponara and Marrecau do not teach or suggest this combination of features.

For example, Saponara and Marrecau do not teach or suggest a metal burner membrane configured such that, during use, gas penetrates before being ignited and resulting in visible flames having a lower flame front where the gas initially ignites outside said membrane. Saponara merely discloses a radiant burner. (See paragraphs 7 and 10 of the Folkers Declaration.) For instance, Saponara discloses "a radiant heater or burner, in which a fluid fuel, such as gas, is burned on the surface of a screen to heat the screen to incandescence." (Column 1, lines 9-15 of the Office Action.) Saponara explains at column 1, lines 46-63:

A radiant burner includes an outer, combustion-sustaining screen which is heated to incandescence and at least one inner foraminous member such as a screen which shields the burner head from the flame on the outside surface of the outer screen. The outer screen is heated to a much higher temperature than the inner foraminous member and, if the outer screen is flat and contacts the inner foraminous member over its entire surfaces, the movement of the outer screen, due to its greater expansion and contraction, will be impeded and will exert a drag on the inner foraminous member with permanent deformation or damage to one, or both, of these elements. It is therefore a still further object of the invention to produce an improved burner in which the contact between the outer screen and the inner foraminous member is reduced to a minimum so as to permit relative movement of the screens without damage to either of them.

Saponara discloses with the above passage that, for radiant burners, gas does not penetrate through the outer combustion-sustaining screen so as to result in a flame having a lower flame front where the gas initially ignites outside the outer combustion screen. Indeed, the outer screen is protected with an inner foraminous screen to shield the burner head from the flame. The inner screen is used to protect the outer screen from the combustion gas so one of ordinary skill in the art would understand that, for radiant burners, gas does not penetrate the outer screen and then start combusting.

The PTO cites column 1, lines 46-55 for support that the "flame is on the outside surface of the outer screen" (Page 3 of the Office Action). It is respectfully submitted that the phrase "a screen which shields the burner head from the flame on the outside surface of the outer screen" means that the screen shields the burner head from a flame on the outer surface on the inner face of the outer screen. The inner screen, by virtue of its placement on the inner side of the outer screen, would not shield the burner head from a flame on the outer surface of the outer face of the outer screen (as suggested by the PTO). Accordingly, column 1, lines 46-55 of Saponara does not support a teaching or suggestion that a flame is meant to be combusted on the outer surface of the outer face of the outer screen. Indeed, if a flame were to exist on the outer surface of the outer face of the outer screen, the inner screen would be completely inadequate to shield the burner head from the flame at this location. Accordingly, one of ordinary skill in the art would not understand Saponara teaching or suggesting a metal burner membrane configured such that, during use, gas penetrates before being ignited and

resulting in visible flames having a lower flame front where the gas initially ignites outside said membrane. (See paragraphs 10-11 of the Folkers Declaration.)

Marrecau does not cure the deficiencies of Saponara because Marrecau does not teach or suggest a metal burner membrane configured such that, during use, gas penetrates before being ignited and resulting in visible flames having a lower flame front where the gas initially ignites outside said membrane. Marrecau discloses a burner operating in a radiant mode. (See paragraphs 7 and 10 of the Folkers Declaration.) A radiant burner like that disclosed in Marrecau is designed to have combustion inside the membrane with substantially no external flame to make the membrane incandescent. (See paragraphs 7, 10 and 12 of the Folkers Declaration.) The purpose of a burner working in a radiant mode is to generate infrared radiation. (See paragraph 7 of the Folkers Declaration.) This is achieved by having the combustion of the gas inside the membrane, whereby the generated heat immediately heats up the stainless steel which starts to emit radiation. The Stephan-Boltzmann law for black body radiation describes the emission of radiation to be proportional to the fourth power of the absolute temperature of the body. (See paragraph 7 of the Folkers Declaration.) It is respectfully submitted that the gas burner of claim 1 and the radiant burner of Marrecau are two different types of burners in which the physics governing both types of burners are totally different. (See paragraphs 7-8 of the Folkers Declaration.) Hence, the gas burner of claim 1 in which the flame is initially ignited outside of the membrane and exists outside of the burner is simply not the same as the radiant burner of Marrecau (or Saponara) in which the flame remains within the membrane and is not initially ignited outside the membrane.

The PTO asserts on page 16 of the Office Action that

There are basically three types of radiant burners well known to someone of ordinary skill in the art. Radiant burners in which the gas combusts before penetrating the membrane, radiant burners in which combustion occurs within the membrane and radiant burners in which the flame is produced on the outer surface of the membrane (as is the case with the applicants invention). Of the three basic types of radiant burners, there are hybrid radiant burners which employ a mixture of the three above conditions. Since the reference of Marrecau does not clearly state where combustion occurs, the new reference of Saponara has been used to address newly amended claim 1 where "the gas ignites outside said membrane".

Applicants respectfully disagree. First, as previously mentioned, Saponara does not disclose that the gas initially ignites outside the outer face of the outer screen. Second, the statement of there being three types of well-known radiant burners is unsupported by any evidence. Third, the statement that there is a type of radiant burner in which the flame is produced on the outer surface of the membrane is not supported by any evidence. Indeed, one of ordinary skill in the art would not understand a radiant burner (such as those disclosed in Saponara and Marrecau) to be a metal burner membrane configured such that, during use, gas penetrates before being ignited and resulting in visible flames having a lower flame front where the gas initially ignites outside said membrane.

The declaration of Geert Folkers sets forth the comparison between radiant burners versus non-radiant burners. Saponara and Marrecau each discloses a radiant burner. (See paragraph 7 of the Folkers Declaration.) A burner operating in a radiant mode is designed to have combustion inside the membrane with substantially no external flame to make the membrane incandescent. *Id.* The purpose of a burner working in radiant mode is to generate infrared radiation. *Id.* In contrast, the present invention is not a radiant burner but relies upon a flame being present outside of the membrane. (See paragraph 8 of the Folkers Declaration.) Such a gas burner operates in the “blue flame mode.” *Id.* In a gas burner operating in a “blue flame mode,” the intention is to control the gas flow pattern as the gas is first ejected out of the burner and then the gas is ignited. The membrane itself serves to distribute the gas but the purpose of a gas burner is to generate heat, and not to increase the temperature of the membrane *per se*. *Id.*

The difference between the gas burner of present invention working in a blue flame mode and the radiant burner of Saponara and/or Marrecau working in a “radiant mode” is that in the former, the gas penetrates the membrane before being ignited. (See paragraphs 8-10 of the Folkers Declaration.) In other words, the membrane of the present invention does not necessarily heat up appreciably to emit a red glow but relies upon the flame outside the membrane for heating. (See paragraph 10 of the Folkers Declaration.) Indeed, as explained in paragraphs 8-9 of the Folkers Declaration and accompanying exhibits, there is no more radiant output at 1 MW/m<sup>2</sup> as the membrane does not heat up anymore. (See Fig. 3.3 of Exhibit 1 of the Folkers Declaration.) The burner of the present invention is operating above this region of output (that is, the burner of the present invention operates in the region where

the gas penetrates the metal burner membrane before being ignited outside the membrane). One of ordinary skill in the art would not operate the radiant burners of Saponara and/or Marrecau so as to have gas penetrate the membrane before being initially ignited because the uncombusted gas would lower the temperature of the membrane, which would run contrary to operating the membrane to reach its optimum temperature for radiant mode operation. (See paragraph 11 of the Folkers Declaration.) Accordingly, one of ordinary skill in the art would not operate a radiant burner such that gas penetrates the membrane before igniting.

Because Saponara and Marrecau do not teach or suggest a metal burner membrane configured such that, during use, gas penetrates before being ignited and resulting in visible flames having a lower flame front where the gas initially ignites outside said membrane, claim 1 is allowable over Saponara and Marrecau.

Furthermore, Saponara and Marrecau do not teach or suggest that the transition region has a smallest radius of curvature  $r_{transition}$  being larger than or equal to  $0.02 \times R_{base}$  and being smaller than or equal to  $0.7 \times R_{base}$ . The PTO seems to concede this point but then asserts on pages 4-5 of the Office Action.

It would have been obvious at the time the invention was made to a person having ordinary skill in the art to optimize the range of the transition radius of curvature of Saponara for the purpose of optimizing the flame shape and heat output range of the burner. It is well known to someone of ordinary skill in the art that an undulated burner membrane can raise the heat output of a radiant burner higher than a conventional flat type radiant burner. Therefore, it would have been obvious to optimize the range of the transition radius of curvature of Saponara burner membrane to obtain a desired heat output of the radiant burner. Optimizing the range and curvature of the membrane would be well within the capabilities of someone of ordinary skill in the art and would not have led to undue experimentation at the time of the invention.

It is respectfully submitted that this analysis is incorrect. If the membrane of the resulting combination of Saponara and Marrecau were to be optimized, one of ordinary skill in the art would optimize the resulting combination for its operation as a radiant burner. (See paragraph 13 of the Folkers Declaration.) Saponara discloses that the optimization of the radiant burner would involve optimizing the burner so as to achieve a uniform combustion

over the entire inner surface of the radiating membrane. (See paragraph 14 of the Folkers Declaration and column 1, lines 64-72 of Saponara.) In contrast, the present invention relates to a metal burner membrane configured such that, during use, gas penetrates before being ignited and resulting in visible flames having a lower flame front where the gas initially ignites outside said membrane, which is not a radiant burner. (See paragraph 15 of the Folkers Declaration.) The configuration of the present invention permits large variations in gas flow rate through the membrane using the same burner because of the different gas speeds though the burner membrane. (Page 3, lines 11-25 of the specification.) Because the radiant burner of the combination of Saponara, and Marrecau has the goal of achieving a uniform combustion over the entire inner surface of the radiating membrane that is in direct conflict with the burner of the present invention which has the goal of achieving large variation in gas flow rate through the membrane, one of ordinary skill in the art would not optimize the geometry of the membrane of the combination of Saponara and Marrecau to arrive at the geometry of the membrane of the present invention. (See paragraph 16 of the Folkers Declaration.) Accordingly, one of ordinary skill in the art would not optimize the geometry of the membrane of the combination of Saponara and Marrecau to arrive at the claimed geometrical arrangement of the transition region of the present invention. Thus, claim 1 is allowable over Saponara and Marrecau.

Claims 5, 11, 20-22, and 24-26 depend from and contain all the features of claim 1, and are allowable for the same reasons as claim 1, without regard to the further patentable features contained therein.

For at least these reasons, favorable reconsideration of the rejection is respectfully requested.

Rejection of claims 3-4 and 10 based on Saponara, Marrecau and Dewaegheneire

Claims 3-4 and 10 are rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Saponara, Marrecau and U.S. Patent No. 6,065,963 ("Dewaegheneire"). Claims 3-4 and 10 depend from and contain all the features of claim 1. As previously mentioned, Saponara and Marrecau disclose a radiant burner, and they fail to disclose a metal burner membrane configured such that, during use, gas penetrates before being ignited and resulting in visible flames having a lower flame front where the gas initially ignites outside said membrane and

that the smallest radius of curvature of the transition region  $r_{transition}$  is in the range of  $0.02 \times R_{base}$  to  $0.7 \times R_{base}$ . Dewaegheneire does not cure these deficiencies. Thus, claim 1 and its dependent claims 3-4 and 10 are allowable over Saponara, Marrecau and Dewaegheneire.

Also, none of Saponara, Marrecau, and Dewaegheneire is concerned with increasing the dynamic range of the gas burner membrane which is the prime concern of the invention of claim 1. (See page 1, lines 26-27; page 3, lines 11-27; and page 8, lines 19-22 of the specification.) None of Saponara, Marrecau, and Dewaegheneire discuss the impact the radii of curvature has on the flame front. (See paragraphs 13-16 of the Folkers Declaration and Fig. 3b and page 8, lines 11-17 of the specification.) Thus, one of ordinary skill in the art would not be able to combine Saponara, Marrecau and Dewaegheneire to arrive at the invention of claim 1. Thus, claim 1 and its dependent claims 3-4 and 10 are allowable over Saponara, Marrecau and Dewaegheneire.

For at least these reasons, favorable reconsideration of the rejection is respectfully requested.

Rejection of claims 12 and 16-18 based on Saponara, Marrecau, Dewaegheneire, and Sterick

Claims 12 and 16-18 are rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Saponara, Marrecau, Dewaegheneire, and U.S. Patent No. 2,822,799 (“Sterick”). Claims 12 and 16-18 depend from and contain all the features of claim 1. As previously mentioned, Saponara, Marrecau and Dewaegheneire fail to disclose a metal burner membrane configured such that, during use, gas penetrates before being ignited and resulting in visible flames having a lower flame front where the gas initially ignites outside said membrane and that the smallest radius of curvature of the transition region  $r_{transition}$  is in the range of  $0.02 \times R_{base}$  to  $0.7 \times R_{base}$ . Sterick does not cure all these deficiencies. Thus, claim 1 and its dependent claims 12 and 16-18 are allowable over Saponara, Marrecau, Dewaegheneire, and Sterick.

Furthermore, one of ordinary skill in the art would not combine Saponara, Marrecau, Dewaegheneire, and Sterick in order to arrive at the claimed invention of claim 1 because the burners of Sterick are concerned with the reflecting of heat using metal fibers. (Column 1, lines 58 to column 2, lines 5 of Sterick.) Although there is a plurality of holes 8b and 15a for venting the fumes from the burner, there is no reason to use the metal shield 8 or 15 of Sterick

as a burner membrane through which gas penetrates. The use of the heating unit of Sterick with the burners of Saponara, Marrecau and/or Dowaegheneire to arrive at the gas burner of claim 1 is not straightforward as they concern totally different types of burners wherein the fibers are used as insulation materials in one instance and a material for a burner membrane in another instance.

Furthermore, the use of the shield 8 or 15 of Sterick in the membrane of either Saponara, Marrecau or Dowaegheneire changes the function of the shield of Sterick, which makes the proposed modification non-obvious. MPEP 2143 suggests that a conclusion that a claim would have been obvious when all the claimed elements were known in the prior art, one of ordinary skill in the art could have combined the elements with no change in their respective functions, and the combination yielded nothing more than predictable results cannot be made if there is a change in the function of the element found in the prior art. Because the shield of Sterick has a change in function from a reflector of heat to a burner membrane where gas penetrates therethrough in the proposed combination, the proposed modification based on the teachings of Sterick is improper, and claim 1 and its dependent claims 12 and 16-18 are allowable.

For at least these reasons, favorable reconsideration of the rejection is respectfully requested.

Rejection of claims 13-15 based on Saponara, Marrecau, and Karlovetz

Claims 13-15 are rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Saponara, Marrecau, and U.S. Patent 3,857,670 (“Karlovetz”). Claims 13-15 depend from and contain all the features of claim 1. As previously mentioned, Saponara and Marrecau fail to disclose a metal burner membrane configured such that, during use, gas penetrates before being ignited and resulting in visible flames having a lower flame front where the gas initially ignites outside said membrane and that the smallest radius of curvature of the transition region  $r_{transition}$  is in the range of  $0.02 \times R_{base}$  to  $0.7 \times R_{base}$ . Karlovetz does not cure all these deficiencies. The gas burner membrane of Karlovetz is consistently identified with number 18 in the patent. However, it is mentioned that “[t]he central portion of layers of mesh are welded to each other at the points indicated by the reference number 23 and, after welding, the central portions are coined convex” for pre-establishing the direction of

expansion of the screen. (Column 4, lines 32-34 of Karlovetz.) Fig. 6 of Karlovetz shows that the bulging is slight and the curvature does not meet the claimed range of  $r_{transition}$  of claim 1. Moreover, the burner membrane is built up of different meshes and not from stainless steel fibers. Karlovetz, therefore, does not cure the deficiencies of Saponara and Marrecau, and claim 1 and its dependent claims 13-15 are allowable over Saponara, Marrecau, and Karlovetz. For at least these reasons, favorable reconsideration of the rejection is respectfully requested.

Allowability of claim 27-33

Claims 27-28 depend from and contain all the features of claim 1, and are allowable for the same reasons as claim 1 without regard to the further patentable features contained therein.

Claim 29 recites, among other things, penetrating gas through a metal burner membrane before igniting the gas, the membrane having a surface that is uninterrupted; igniting the gas such that visible flames having a lower flame front where the gas initially ignites outside the membrane are produced; and modulating gas speed through the membrane over the surface of the membrane by changing a smallest radius of curvature at different sections of the membrane. As previously mentioned, Saponara and Marrecau fail to disclose a metal burner membrane configured such that, during use, gas penetrates before being ignited and resulting in visible flames having a lower flame front where the gas initially ignites outside said membrane. They also do not teach or suggest modulating gas speed through the membrane over the surface of the membrane by changing a smallest radius of curvature at different sections of the membrane. Dewaegheneire, Sterick, and Karlovetz do not cure all these deficiencies. Thus, claim 29 is allowable.

Claims 30-33 depend from and contain all the features of claim 29, and are allowable for the same reasons as claim 1 without regard to the further patentable features contained therein.

For at least these reasons, allowance of claims 27-33 is respectfully requested.

Conclusion

Applicants believe that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by the credit card payment instructions in EFS-Web being incorrect or absent, resulting in a rejected or incorrect credit card transaction, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicants hereby petition for such extension under 37 C.F.R. §1.136 and authorize payment of any such extensions fees to Deposit Account No. 19-0741.

Respectfully submitted,

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